PROJECT PRIORITY PROCESSES

CAPACITY NEEDS

Forecast travel information was used to identify future capacity needs and potential improvements. The travel forecasting model was developed by King County DOT staff using EMME/2 travel demand forecasting modeling software.

The model was calibrated to base year 2000 conditions using 2000 census data, existing roadway information, and empirical traffic count data. Detailed documentation of this model resides in the offices of the King County Department of Transportation, Roads Services Division.

A forecast year of 2022 was chosen consistent with the land use element of the comprehensive plan as required by state growth management legislation (RCW36.70A.070(6)). The model was run with regionally-adopted, 2022 target land use data for population and employment distributed to the model's zonal system. Growth targets and land use assumptions are included in Appendix A of this document. The model road network was developed to represent existing conditions plus a limited number of capacity projects that were considered committed for development and therefore certain to be in place by 2022. The Washington State Department of Transportation's 20-year list of transportation improvements to the state highway system was included in the network as were city projects that were listed in the 20-year time horizon of the regional plan, Destination 2030. City and state projects are listed in Appendix B.

By forecasting future year travel demand on a roadway network comprised of only existing and committed projects, it is possible to highlight areas that lack the capacity needed to accommodate the travel demand associated with the target year. This capacity needs information was identified by analyzing model results using forecast traffic volumes and forecast ratios of traffic volumes to roadway capacity.

Once the areas of forecast needs were identified, additional capacity was coded into the network to represent projects that might accommodate those needs. The model was run again using 2022 land use data. The results were analyzed using forecast traffic volumes, forecast ratios of traffic volumes to roadway capacity, and existing traffic count data. Additional adjustments were made to model network capacity to optimize performance. This process was repeated several times to identify the best set of capacity projects for meeting forecast needs based on the assumptions and conditions represented in the model.

The resulting needs represents the network capacity increases added to the final or optimum model run. This list represents the roadway capacity needs for 2022 assuming the regionally-adopted land use forecasts for population, households, and employment used to develop the land use component of the King County Comprehensive Plan 2004. All needs identified through this process are included in the needs list section of this document. Needs are also shown on maps included in Section III.

Since the capacity needs clearly exceeded available revenues, a priority scoring methodology was developed to help balance needs with available revenue. This methodology incorporated existing, empirical data; forecast data for 2022 without an improved roadway network; and forecast data for 2022 with an improved roadway network. The following data elements were collected, calculated, and scored:

- Average weekday traffic
- Existing traffic volume to roadway capacity ratios
- 2022 forecast volume to capacity ratios (without capacity improvement)
- 2022 forecast traffic volumes with capacity improvements
- Ratio between 2022 traffic volumes to roadway capacity for the unimproved network compared with the volume to capacity ratio for the improved network
- Arterial Classification of the project need

A description of this scoring system is included in the following table.

Priority Scoring for Capacity Projects

EXISTING Average Daily Traffic (ADT) for project

5 groupings based on magnitude of ADT – from Count Station locations

ADT Value	**Score**
>20,000	5
15,000 – 20000	4
10,000 – 15,000	3
5,000 – 10,000	2
<5,000	1

EXISTING Volume to Capacity Ratio (V/C) problem in 2000 – from the model

5 groupings based on severity of V/C

V/C Value	**Score**
>1.2	5
1.0 – 1.2	4
8. – 1.0	3
.6 - .8	2
<.6	1

Yr 2022 V/C problem without improvements

5 groups rated on severity of V/C problem

V/C Value	**Score**
>1.4	5
1.2 – 1.4	4
1.0 – 1.2	3
.6 – 1.0	2
<.6	1

Year 2022 ADT with final recommended improvements

ADT Value	Score
>40,000	5
30,000 to 40,000	4
20,000 to 30,000	3
10,000 to 20,000	2
<10,000	1

Year 2022 Improvement in V/C, Recommended Improvement verses no action

Value	Score
> .6 V/C change	5
.5 to .6 V/C change	4
.4 to .5 change	3
.3 to .4 V/C ratio	2
.2 to .3 V/C ratio	1

SYSTEM-Level ratings

Arterial Classification

Value	Score
Principal	3
Minor	2
Collector	1
Local	0

FINAL SCORES AND GROUPING

Score 27 to 24 = High Priority Group
Score 23 to 20 = Medium Priority Group
Score 19 and below = Low Priority Group

NON-CAPACITY NEEDS

Non-capacity needs are prioritized by groups of like needs. Existing prioritization processes have been developed either in-house or by consultants for various categories including bridge, guardrail, high accident location, traffic signals, and others.

The prioritization processes for some groups of non-capacity needs are under review and development. When developed, these processes will be used in a 2006 interim update to the TNR. The following are under development as work program items:

- Non-motorized
- Traffic Operations
- Roadway Reconstruction
- Culvert Replacement and Habitat Restoration
- Intelligent Transportation System

Existing prioritization processes used to develop the TNR are summarized below.

ITS Needs

Prioritization of ITS projects was based on an interim methodology developed by King County Department of Transportation, Road Services Division, Traffic Engineering Section, Systems Unit. The methodology includes three sets of criteria for evaluating candidate corridor projects resulting in designations of high, medium, or low priority.

Most candidate projects were identified from information that had been used by Metro Transit Speed and Reliability Signal Synchronization Grant Program. Candidates also included seven principal arterials with a history of congestion problems as measured by travel time. Projects that had been awarded grants were excluded from the list of candidate projects. Engineering staff identified a few additional candidate projects including arterials considered regionally significant because they provide links between urban areas.

Candidate projects did not necessarily meet all criteria for a particular category. How strongly projects met each criterion was considered when ranking projects as high, medium, or low. The following criteria were used in the ranking process:

High Priority Project Criteria:

- Among 7 identified congested principal arterials
- Along Metro Bus Rapid Transit routes.

Medium Priority Project Criteria:

- High volume, highly-congested corridors
- High bus use
- Corridors that link into other ITS projects, continuing high speed communication
- Feasibility
  - WSDOT fiber usage
  - Number of Signals and distance between

Low Priority Criteria:

- High volume, highly-congested Corridors
- Bus Use
- Corridors that link into other ITS projects, continuing high-speed communication.
- Arterials of regional significance (Issaquah Hobart/ Woodinville Duvall).

A study is underway to develop an ITS Strategic Plan that will include detailed project summaries, an evaluation and prioritization of projects, and a recommended schedule for implementation. Results of this study will inform future TNR updates.

<u>High Accident Location (HAL) and High Accident Road Segment (HARS) Needs</u>

In 2002-2003 the King County Department of Transportation list of prioritized High Accident Location (HAL) and High Accident Road Segment (HARS) Needs was updated. The first step in this process was to develop a list of candidate HAL and HARS locations for review and analysis. An initial list was compiled based on accident data from the three-year period 1998-2000. The list was made up of locations that had eight or more recorded accidents in the three-year period.

Certain locations were eliminated from consideration for inclusion in the final list of HAL and HARS locations and needs. These include:

- Locations where recent improvements were judged likely to have a significant effect on the predominant accident patterns were omitted as were locations slated for near-term improvements judged likely to have a significant effect on the predominant accident patterns.
- Locations requiring additional data or analysis were identified and eliminated.
- Any locations that had been recently annexed by other jurisdictions were excluded.
- Sites with no clear accident pattern and no noted deficiencies were excluded.
- Several locations have accident rates considered normal for their ADT. This is a result of their being selected based on the number of accidents in a 3-year period as opposed to accident rate. Sites with normal accident rates, no clear accident pattern, and no noted deficiencies were excluded.

- A few locations were eliminated because the only countermeasures that could be determined were deemed infeasible based upon their impact on traffic flow.

Relevant data were collected for each HAL and HARS location. Field trips were made to collect site-specific data. Site diagrams were sketched, and sites were photographed. This information was added to traffic volume data and accident data from King County's database and was used in the subsequent location-specific analysis. Accident data were used to identify predominant accident patterns.

Although each HAL and HARS location is unique, certain accident patterns are indicative of site deficiencies that can be addressed by specific countermeasures. Countermeasures are improvements that address the accident patterns at a given location. The purpose of a countermeasure is to reduce the occurrence of accidents. There is a broad range of countermeasures, with approaches ranging from changing roadway geometrics to altering traffic signal timing.

Countermeasures were developed for each of King County's HAL and HARS locations based on predominant accident patterns, field observations, County practices, and the experience of the review team.
General assumptions were made based on average daily traffic (ADT) as to the general suitability of certain countermeasures such as the installation of new signals and left-turn channelization.

Although safety is a primary objective when developing countermeasures, other factors, such as level of service impacts, must be considered. Consideration also was given to the County's standard practices and procedures. County practices deemed applicable to the countermeasure selection process are:

- At signalized intersections, the use of split phasing is discouraged.
- Where no left-turn phasing exists, County practice is generally to first implement protected/permissive left-turn phasing prior to exclusive protected left-turn phasing.
- Where advance-warning signs already exist and accidents still occur, the next step is to install flags to warning signs on tangents and flashing beacons to warning signs on curves.
- Warrants need to be met for application of certain countermeasures such as installation of new signals, stop signs, and left-turn channelization.

Each countermeasure is associated with a corresponding accident reduction factor. Accident reduction factors are a measure of the potential effectiveness of a particular countermeasure. (Actual factors used were based on the Kentucky Transportation Center's *Development of Accident Reduction Factors, Research Report, KTC-96-13.*) There are different ways in which accident reduction factors can be applied. Some reduction factors are broken out by accident severity, for example, property damage only, injury, or fatality. Some are broken out by accident type, for example, left-turn, right angle, nighttime. Some general reduction factors are applied to all accidents. In general, when both accident-specific reduction factors and general reduction factors were given for the same countermeasure, the accident-specific reduction factors were applied. This decision was made to avoid over estimation of potential accident reduction resulting from applying multiple general countermeasures addressing the same accident pattern. The accuracy of the predicted accident reduction is a combination of the selection of both appropriate countermeasures and appropriate reduction factors based on individual site circumstances.

Benefit/cost analysis

Once countermeasures were developed and potential accident reductions were calculated, a benefit-cost analysis was prepared for each location. The benefit/cost ratio accounts for economics and therefore is frequently used to prioritize safety improvements. This method was also used to prioritize the 1996 HAL and HARS projects.

Quantification of the benefit of accidents avoided was based on accident cost figures compiled by WSDOT and derived from national sources. The probable number of reduced accidents was multiplied by the estimated WSDOT accident cost and divided by three (corresponding to three years of accident data) to determine an annual benefit. Countermeasure benefits were converted to a present value normalized over 20 years to account for projects with different service lives.

Planning-level countermeasure cost estimates were developed for use in the benefit/ cost analysis. Since the cost estimates could not be based on an actual design, it was necessary to make general assumptions in determining total project costs. To help simplify the cost estimating process, some of the countermeasures and components of countermeasures were assigned lump sum costs.

The benefit/cost ratio is equal to the benefit of the probable accident reduction divided by the project cost. A benefit/cost ratio greater than 1 indicates the benefits of a proposed countermeasure are greater than the costs. For HALs, the benefit/cost ratio ranged from 0.1 to 76 with six countermeasures resulting in a benefit/cost ratio of less than 1.0. For HARSs, the benefit/cost ratio ranged from 0.1 to 211, with ten countermeasures resulting in a benefit/cost ratio less than 1.0.

The results of the benefit/cost analysis and detailed documentation of the process used are contained in the report, *High Accident Locations and Road Segments Analysis, King County, Washington*; Jacobs Civil Inc.; July 2003.

Bridge Needs

Assessment of bridge needs begins with inspection. The inspection system, which is based on the National Bridge Inspection Standards (NBIS), calculates a sufficiency rating based on such factors structural adequacy and safety, serviceability and functional obsolescence, and how essential the bridge is for public use. The rating ranges from zero (worst) to 100 (best). Under this system, all bridges having a sufficiency rating less than or equal to 50 are either functionally obsolete or structurally deficient and are equally eligible for federal replacement funds. Any bridge with a sufficiency rating less than or equal to 80 that is functionally obsolete or structurally deficient is also eligible for rehabilitation funds.

Sufficiency rating alone establishes eligibility for federal funding, but it is inadequate to prioritize bridges for replacement or rehabilitation. It does not give enough weight to important criteria such as load limitations, hydraulics, geometric deficiency, and expected useful life. The priority process establishes the need for individual bridge replacement by score and rank using criteria approved by the King County Council (Ord. 11693).

The bridge seismic study completed in 1994 ranks the relative need of seismic retrofits for each bridge included in the study. Bridges scheduled for replacement or rehabilitation within 10 years were excluded. The study assigned equal weights to four criteria: structural vulnerability, importance, seismicity, and life hazard. The final assessment of which bridges to retrofit considers the potential for the bridge to become a viable replacement candidate and to be replaced within ten years. Consideration is given to such factors as whether the bridge provides a sole access and if the cost of the retrofit is a reasonable amount to invest for a limited period of protection prior to replacement.

Priority process rankings are used in the development of the annual six-year CIP. Highest priority projects are in the current CIP. Consideration for additions are guided by the following goals: add the highest priority bridges to the replacement program, continue with existing seismic retrofit program, establish a routine painting program, and provide for major maintenance and repairs that cannot be accomplished by Maintenance Operations.

The methodology for prioritizing bridge needs is documented in, "Proposed Prioritization Process for King County Bridge Needs," King County Department of Public Works, Roads and Engineering Division, July 1994 and "2002 Annual Bridge Report of the King County Department of Transportation, Road Services Division, Structural Design and Bridge Inspection Unit," April 2003.

Roadside Barrier (Guardrail) Needs

The methodology for identifying and ranking potential sites for safety mitigation using roadside barriers, specifically guardrails and bridge rails, was revised in 2002-2003. The new methodology is quantitative and was used to develop priority arrays for each of three categories of barriers: new barriers, retrofits to existing barriers, and bridge rail upgrades.

The methodology has two principal considerations—risk potential and severity. The risk potential factor is a function of parameters that quantify the exposure and probability associated with vehicles running off the road. Severity is a function of parameters that quantify and rate personal injury potential. These factors were derived from current statistics and existing roadside features. Factors are based on accidents, average daily traffic (ADT), road functional classification, corridor geometry, bridge geometry, speed limit, need as defined by embankment slopes, and roadside obstacles. The algorithms for retrofit barriers and bridge rail upgrades also incorporate parameters for existing barrier and rail deficiencies.

The primary source for establishing potential new barrier locations was the existing barrier priority array initially established in 1988. All locations remaining on the list were included in the array. In addition, a comprehensive roadside hazard inventory was completed for the King County arterial roadway system and analyzed to identify locations that might require barriers. Twenty-one sites were identified for further investigation. Additional non-arterial sites suggested by citizens and county employees were also included.

All sites with existing roadside barriers that are not compliant with standards were included as candidates for barrier retrofit. About have the existing barriers are non compliant and were therefore included as candidates. Risk exposure and degree of deficiency were the primary considerations in the prioritization process. Severity was less of a concern than for new barriers because it was assumed that all barrier locations were warranted.

All bridges and culvert crossings maintained by King County were included as candidates for bridge rail upgrades. Many of the candidate bridges were built prior to 1964 and do not have bridge railings designed to current safety standards. The bridge rail array identifies locations with safety deficiencies and prioritizes their upgrade. Three specific bridge deficiency and difficulty factors were established: structural deficiency, difficulty of upgrade, and end transition deficiency. In addition, a risk potential factor (average daily traffic) and a severity factor (posted speed limit) were included.

Priority arrays were developed for each of the three categories of barrier using the appropriate factors and algorithms. Each priority array was fully tested following development. Statistically valid sample sizes were developed for each array, and engineers field reviewed and ranked the sites. In each case, rankings correlated 90% or better with the results of the priority arrays.

Detailed documentation of priority array development and methodology is available in the document, *King County Roadside Barrier Program Priority Array Development;* September 2003; Jacobs Civil Inc., TransCore ITS, Inc., Garry Struthers Associates, Inc.; for King County Department of Transportation Traffic Engineering Section.

Signal Priority Process

The process to prioritize signals conforms to the laws set forth by the federal government, adopted with amendments by state government, and presented in the *Manual on Uniform Traffic Control Devices* (MUTCD) published by the Federal Highway Administration and the U.S. Department of Transportation. The prioritization process evaluates signal warrants (tests) set forth in the MUTCD and assigns rating values to each warrant. The rating values assign weights to the individual warrants. The sum of the individual warrant rating values provides a basis for comparison to other potential signal locations.

Prioritization and selection of intersections for signalization starts with data collection. Traffic Engineering staff members collect data on vehicle and pedestrian volumes, prevailing speeds, and accident history at each intersection over the most recent three-year period. Each intersection is then evaluated using MUTCD warrants based on the number of approach lanes and the collected data.

The MUTCD states that the signal warrants define the minimum conditions under which installing a traffic control signal might be justified. However, selection and use of traffic control signals should be based on careful analysis of traffic operations, pedestrian and bicyclist needs and other factors, coupled with engineering judgment. Traffic signals should not be installed unless one or more of the eight signal warrants is met. Three of these warrants are based on traffic volumes at several periods during the day: the peak hour, the fourth highest hour, and the eighth highest hour. Another warrant examines the traffic accident history, focusing attention of accidents correctable by signalization (left-turn and right-angle types). Two warrants examine pedestrian activity to determine if pedestrian volumes warrant signalization. The final two warrants examine whether signalization would improve traffic flow in a coordinated signal system or roadway network.

Four primary warrants are used in the evaluation of all intersections. The remaining warrants are most applicable to urban sites with frequent pedestrian activity. Such sites are less common in unincorporated King County.

The four primary warrants are:

1. Warrant #1 – Eight-Hour Vehicular Volume
    - Condition A: Minimum Vehicular Volume
    - Condition B: Interruption of Continuous Traffic
2. Warrant #2 – Four-Hour Vehicular Volume
3. Warrant #3 – Peak-Hour Vehicular Volume
4. Warrant #7 – Crash Experience

To the MUTCD warrants, King County adds a factor for proximity to school site. This additional factor does not replace the pedestrian-related warrants. For locations near schools, shopping, and other pedestrian attractors, the volume of pedestrian activity is examined as well as pedestrian warrants. The proximity to school factor addresses the potential for pedestrian activity outside the average-day activities.

Rating values representing the degree to which signal warrants are met are calculated for each warrant. Values are summed by intersection, and the list of intersections is sorted to separate those that meet signal warrants from those that do not. Intersections that meet warrants are sorted by rating value from the largest to the smallest and are then numbered according to their order in the list. The resulting list of rank-ordered intersections is commonly called the priority array. It provides a starting point for determining the locations to signalize.

Intersections on the top of the priority array undergo extensive evaluation of alternatives including existing and forecast traffic operational analyses to determine the effectiveness of each alternative, turn pocket lengths, and cost comparisons. Alternative measures to signalization include, but are not limited to, the construction of additional lanes, revising the intersection geometrics to channelize movements, installing street lighting, improving sight distance, roundabouts, measures to reduce approach speeds, changing lane use assignments, restricting movements, adding stop controls or intersection flashers. Particular attention is given to the predominant type of accident recurring at the intersection. A committee of signal design and maintenance staff reviews the information developed from these analyses and selects the improvement providing the safest, most cost-effective, long-term solution.

Detailed documentation of the signal prioritization process is contained in the report, *King County Countywide Signal Program, Signal Priority Process*, King County Road Services Division, Traffic Engineering Section, July 2004.

Pedestrian Needs

The Pedestrian Priority Process (PPP) focuses on improving the most critical pedestrian facilities in unincorporated King County. This process helps the County identify and prioritize pedestrian walkway improvements for construction. PPP was initiated in response to concerns expressed by the King County Council regarding pedestrian safety. The program uses a rating process developed in 1990-1991.

There are four main steps to the process:

Identification of Candidate Locations – A list of potential improvements is compiled from recommendations by Road Services Division personnel, business and community groups, and the general public.

Preliminary Screening and Scoping of Candidate Locations – Road Services Division employees field check each location to eliminate those that are not significant safety hazards or that are infeasible.

Determination of Priority Process Score – Potential improvements are rated based on the following eight evaluation criteria:

1. auto traffic volume (TV)
2. auto speed limits (Sp)
3. pedestrian volume (PV)
4. physical safety of existing pedestrian facilities (EF)
5. accident history (Ac)
6. appearance on other plans (Pl)
7. linkage to other pedestrian trails and pathways (L)
8. benefits to other travel modes: bicyclists, equestrians, bus riders, and the disabled (M)

Values for these criteria are used in the following formula to derive a total priority score:

2 x {(TV x Sp x PV x EF) + Ac} + Pl + L + M = Priority Score

Evaluation of Candidate Locations – Potential projects are reviewed. Low-scoring projects and those with prohibitive costs are given less consideration. The highest scoring projects are considered candidate projects for inclusion in the Road Services Division capital facilities plans.

Documentation of this process is contained in the report, *The Pedestrian Priority Process,* 1991, King County Roads and Engineering Division.